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Article

The Role of Watershed Management Board in the Rehabilitation of Butuanon River Watershed in Cebu, Philippines

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Abstract

This study was conducted to assess the role of Butuanon River Watershed Management Board (BRWMB) in rehabilitating the Butuanon River in Cebu, Philippines. Data was gathered through key informant interviews with officials of the Board and a self-administered questionnaire for the members of the Board and was analyzed through descriptive and thematic analyses. Results showed that since the creation of the Butuanon River Watershed Water Quality Management Area (BRW WQMA) in 2014, the river's biological oxygen demand (BOD) level has decreased. While the level has yet to meet the water quality guidelines of DENR's Class D rivers, the Board's initiatives like clean-up activities, information, education, and communication (IEC), and the relocation of informal settlers residing at riverbanks contributed to the improvement of the river's water quality. The activities conducted by the Board strengthened the linkages with other stakeholders. The good working relationship among the stakeholders facilitated the convergence of their resources, making their efforts to rehabilitate the Butuanon River more coordinated and sustainable. Furthermore, Mandaue LGU, the chair of BRWMB, integrated its efforts in its Comprehensive Land Use Plan (CLUP) and the 10-year Action Plan of the BRW WQMA in its Butuanon River Rehabilitation Plan. Results revealed that the existence of BRWMB played a vital role in the Butuanon River's rehabilitation, and such efforts are hoped to be sustained with the participation of the various stakeholders and formulation of policies to support all efforts of the Board.

Keywords— *role of BRWMB; rehabilitation of the river, sustainable river management*

1 Introduction

Access to water is a right for everyone. Unfortunately, billions of people worldwide have no access to safely managed drinking water, defined as water accessible on premises, available when needed and free from contamination. In the Philippines, around 1 in 10 people still do not have access to improved water sources [1]. Until now, about 11 million Filipinos have no access to clean water [2].

With the worsening problem of access to water, Republic Act 9275, or the Philippine Clean Water Act of 2004, was enacted. This Act protects the country's water bodies from pollution from land-based resources (industries and commercial establishments, agriculture and community/household activities). It is also in this Act that the Environmental Management Bureau (EMB), through the Department of Environment and Natural Resources (DENR) in coordination with the NWRB was tasked to identify Water Quality Management Areas (WQMA) in each region of the country [3]. WQMA aims to protect, through stakeholders collaboration, the water body and its tributaries by keeping their water quality within the Water Quality Guidelines or Criteria conforming to the water body's classification (e.g., Class C or Class SC) or even improve the quality to higher classification (e.g., from C to B or SC to SB). Identifying different areas can be used to manage water resources effectively. The Butuanon River Watershed (BRW) WQMA is one of the 40 WQMAs in the country and has its governing Board and a local counterpart, the Butuanon River Watershed Management Board (BRWMB). Of the 40 WQMAs, 22 are in Luzon, 8 in Visayas and 10 in Mindanao [2].

While the number of WQMAs continue to increase through the years, very few studies have been conducted to determine what these WQMAs have done to improve the water quality in their respective areas. For instance, Kumar et al. (2020) proposed an integrated method combining participatory approaches and computer simulation modeling to assess the current water quality in Santa Rosa Sub-watershed and simulate future scenarios considering the population growth, climate change, and various countermeasures [4]. In another study, Walag et al. (2018) found that, while legal frameworks and policies have been established with the mandate of quality control, regulation of water use, and water supply management in the Philippines, the realization of providing clean and potable water for all Filipinos is still challenged by the weak reinforcement of these policies resulting to various health and environmental impacts on water system accessibility, distribution, and quality [5]. Guerrero & Fernandez (2018) supported these claims as they found that many laws and regulations remain unenforced due to inconsistencies and lack of capacity to monitor resources and enforce laws as well as the low level of participation of diverse and multi-level partners toward sustainable water quality management [6]. Furthermore, Tabios et al. (2018), found that despite all the framework and action plans, there was lack of strong leadership and coordination to ensure efficient and effective management of the country's water resources, since there are more than 30 agencies with water related powers causing overlaps and fragmentation [7].

This study aimed to assess the role of the Butuanon River Watershed Management Board in the rehabilitation of the Butuanon River in Cebu, Philippines. Specifically, it sought to:

1. describe the role of the BRWMB and their perceived impacts in the rehabilitation of the BRW;
2. discuss the initiatives of BRWMB before and after the establishment of the Butuanon River Water Quality Management Area (BRW WQMA) and its accomplishments;
3. explain the water quality changes before and after the establishment of the Butuanon River Water Quality Management Area; and
4. formulate recommendations to improve the rehabilitation of the BRW by the BRWMB and BRW WQMA towards sustainable water resource management.

The framework utilized in the study incorporated the IWRM components from the article of Hassing et al. (2009) [8]. The principles employed on the structures with an enabling environment

could produce sustainable water resource allocation and provision of services. Figure 1 illustrates the conceptual framework used in the study. In the designation of BRW as a WQMA, with the improvement of its water quality through rehabilitative activities and the participation of its river stakeholders, the governing body of the WQMA works closely with the BRWMB.

2 Methodology

Cebu is a province of the Philippines located in the Central Visayas (Region VII) region comprising the main island of Cebu and 167 surrounding islands and islets. It is 196 kilometers long and 32 kilometers in width. Four seas surround the island of Cebu: the Visayan Sea to the north, Tanon Strait to the west, Bohol Strait to the southeast, and the Camotes Sea to the east. The municipalities and cities encompassing the river system and the focus of the study are the following: Cebu City, Mandaue City, and the Municipality of Consolacion.

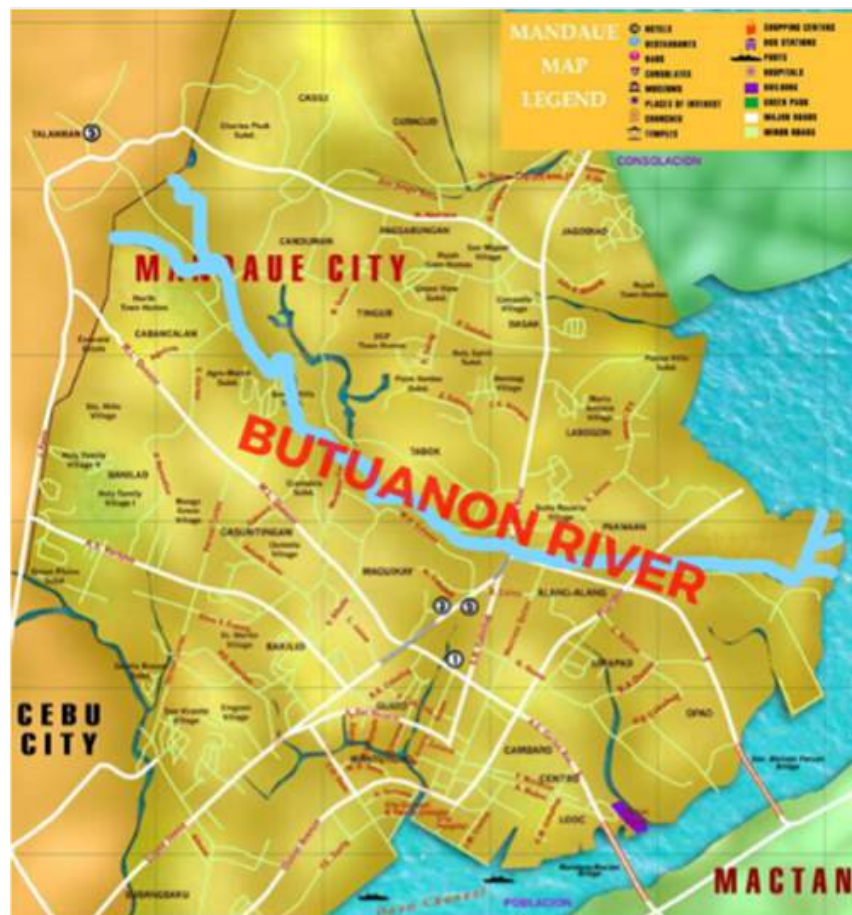


Figure 1.
Map of Butuanon River Watershed (Mandaue Map, 2020)

A case study design was employed, focusing on the BWRMB and the BRW WQMA governing boards. The respondents were the BRWMB and the governing body of the WQMA. The researcher conducted a semi-structured key informant interview with the chairperson of the WQMA governing board, its secretariat, the chairperson of the BRWMB, and its secretariat. Meanwhile, a survey was conducted among the members of the BRWMB, which 17 out of 24 answered.

To limit its scope, the study only focused on Mandaue City BRWMB's roles, functions, and initiatives in relation to river rehabilitation and water resource management. The results of this study may not be reflective of the other regional or local WQMAs in the country.

Lastly, the biological oxygen demand (BOD) level was mainly used as the parameter used to measure the water quality of BRW. Additionally, the Total Suspended Solids (TSS), pH level, and river temperature, which were gathered in the quarterly water quality monitoring of the BRW WQMA, were also used. Other parameters that may also affect the water quality of BRW were not considered in this study.

A series of key informant interviews were conducted among selected officers of the BRWMB and the BRW WQMA governing Board to compare and contrast their understanding of the principles of the WQMA using a semi-structured interview guide. The main points of the interview guide are:

- (1) the profile of the interviewee;
- (2) role and function as a member of the BRWMB;
- (3) past and current initiatives of the member organization and agency;
- (4) statutory responsibilities;
- (5) over-all management assessment rating and justification;
- (6) challenges and limitations; and
- (7) solutions implemented including their role in challenges and support in the management of Butuanon River.

Meanwhile, a self-administered survey was conducted among members of the BRWMB. Furthermore, a document review of secondary sources (e.g., meeting minutes, local policies, LGU progress reports, etc.) was done. Descriptive and thematic analyses were used.

The researchers also ensured that the study's conduct complied with the ethical standards for researchers involving human participants. Before the actual data gathering, a courtesy call with the city mayor of Mandaue City was made to seek approval for the study's conduct. After the approval of the City Mayor, a letter was sent and approved by the officers of the BRWMB. Aside from the approval of the officers, a request letter was sent by the key informants and respondents seeking their consent to be a part of the study and assuring them that the study results would be treated with strict confidentiality. Data gathering proceeded once the KIs and the respondents gave their consent. While undergraduate research is not required to be subjected to the Research Ethics Board, the researchers ensured that the conduct of research complied with the requirement of the Department's rigorous review by the adviser and the Department's research and instruction committee members.

3 Results and Discussion

3.1 Establishment of the Butuanon River Watershed Management Bureau (BRWMB) and Water Quality Management Area (WQMA)

In the early 90s, the sudden increase in the population contributed to the escalated waste production in the Butuanon River Watershed. Consequently, the absence of a government agency mandated to monitor the environmental compliance of the industries and housings in Mandaue City and nearby areas also resulted in the eventual river pollution. In response to this problem, the Butuanon River Watershed Management Board (BRWMB) was created in 1996 through the initiative of the Mandaue City Government in partnership with the United States Asia Environmental Partnership (USAEP).

However, in its 20 years of existence, the rehabilitation of the river progressed slowly [9]. During that time, the river remained chemically and physically polluted due to over 60 commercial and

industrial firms discharging their wastewater. Of the 60 firms, only 33 have proper wastewater treatment facilities.

With this, EMB-DENR, through Section 5 of RA 9275, was tasked to consider areas with appropriate physiographic units (e.g., watershed, river basins or water resources regions) to be assigned a Water Quality Management Area (WQMA). The WQMA aims "...to protect, through stakeholders' collaboration, the water body and its tributaries by keeping their water quality within the Water Quality Guidelines or Criteria". Whenever an area is designated as a WQMA, the Governing Board (GB) will make the action plan. The GB will also be responsible for actualizing the plan and shall be composed of relevant national government agencies' representatives, local government units (LGUs) represented by their respective governors and mayors, duly registered non-government organizations, business sector, and water utility sector; the chair of the Board shall be a representative of the EMB-DENR [2].

DENR DAO 2014-05 designated the Butuanon River Watershed as a Water Quality Management Area (WQMA) [3]. With the creation of the BRW WQMA in 2014, the Governing Board identified more specific goals in their 10-year Action Plan [9]. The water quality management objectives specified on upon its creation are to:

1. improve the water quality of Butuanon River Watershed and thereby contribute to the enhancement of the Cities of Cebu and Mandaue and the municipality of Consolacion, as a source of water for irrigation and other agricultural uses and serve the best interest of the communities and stakeholders;
2. formulate a WQMA program on water quality management which recognizes that water quality management issues are inherently related and cannot be detached from concerns on water sources, ecological protection, water supply, public health and quality of life;
3. mobilize, encourage and support civil society and other sectors, including the academe and businesses engaged in environment-related activities in their efforts to organize, educate and motivate the people in addressing pertinent environmental issues and problems in the WQMA;
4. promote inter-LGU and stakeholder collaboration and cooperation through coordinated efforts in protecting and sustaining acceptable quality of water in the Butuanon River Watershed; and
5. harness locally available resources to support rehabilitation and protection efforts for the Butuanon River Watershed.

3.2 A comparison of the Butuanon River Watershed Management Bureau (BRWMB) and Water Quality Management Area (WQMA)

The roles and functions of the BRWMB and BRW WQMA governing Board were stipulated in the Mandaue City local ordinance No. 13-889-2014 and DAO-2014-05 respectively. The function of BRWMB is distinguished from the BRW WQMA governing Board, but ultimately, both organizations, have the same goal of managing the BRW as a continued water resource.

Results of the key informant interviews showed that the BRWMB members are aware of the broader and more comprehensive composition of the BRW WQMA governing Board compared to that of the BRWMB. However, they also mentioned that as part of both bodies, the BRWMB exists not to contradict the actions and decisions of the BRW WQMA but to support and reinforce the other. At the same time, since the LGUs of Cebu and Mandaue are both members of the BRW WQMA, holding each other accountable is made even more convenient. The synchronized efforts of the

national and local government in implementing the CWA strengthens the actualization of the action plan [10]. Subsequently, the synergy of the national government and the LGUs encourages the participation of the local community in its rehabilitative efforts and water resource management.

"The WQMA board has a wider scope. Si Mandaue is naa'y Butuanon River Watershed Management Board, mas direct na siya nga nakatutok kang Butuanon. Pero kahibaw mi, aware mi nga si Cebu City is aware sad. Mura ba og wala sad mi nila gi-deadma, wala man gyud sila'y paltas. Mu-attend man jud sila sa board meeting gyud. Their role most of the time is to present the updates from their side. Mao ra gyud na. Maghibal-anay ba, nga mao ni ang programs ni Mandaue, mao sad ni ilaha. Very comprehensive ang WQMA board. Actually, we're different. The same cause, pero lahi mi og kanang mandates. Kanang, gasupport lang gyud mi sa DENR. Wala gyud questions sa among support." – (A. Barlam, personal communication, March 19, 2019)

"The WQMA board has a wider scope. While Mandaue has the BRWMB, which is directly focused on Butuanon that is part of their area of jurisdiction. We are also aware that Cebu City knows of our endeavors and they in turn, also are informing us of what they are doing. Which is what they are doing in our meetings with the governing Board. The WQMA governing board is very comprehensive. Although we are different, we have the same cause. The boards just differ in the mandates. For us, with no questions, we really give our support to DENR."

The EMB 7 Regional Director chairs BRWMB and the governing body of the BRW WQMA and consists of 28 board members with representatives from the National Water Resources Board, Governor's Office, Regional Development Council 7, offices of the mayors of Cebu and Mandaue Cities and Consolacion town, and the 13 government offices in Central Visayas, including Department of Agriculture, and Department of Public Works and Highways, Bureau of Fisheries and Aquatic Resources and National Irrigation Administration. Also included are representatives from the Association of Barangay Captains and the private sector, like the Metropolitan Cebu Water District, Pollution Control Association of the Philippines Inc., two schools, and the Mandaue and Cebu business chambers." (Vestil, 2016). In Resolution No. 1-2017, the body has improved the division of tasks of members, grouping them according to specific Technical Working Groups (TWGs). The Mandaue LGU is also included in the septage and sewerage committee and the community education and public advocacy committee (CEPAC).

Moreover, the GB undertook programs and projects that complement national and local initiatives for water pollution control. Based on the results of the key informant interview, a BRW WQMA governing Board member confirmed that it comprises offices and agencies represented by their regional offices.

"Basically, the members...please refer to DAO 2014-05. Naa dinha ang composition sa GB. The members of the Board are responsible for formulating the 10-year action plan. What makes the WQMA man gud different is that naa na kumpleto ang NGAs and apil ang Cebu City (LGU). It's not... it's very comprehensive kay naa na ang Cebu City then membership also include the ABCs (Association of Barangay Captains)."

"Basically, the members...please refer to DAO 2014-05. The composition of the governing Board is stated there. The members of the Board are responsible for formulating the 10-year action plan. What makes the WQMA different is that, the national government agencies (NGAs) are in it including the LGU of Cebu City. The governing Board has a comprehensive membership since the association of barangay captains (ABCs) are part of it also."

Furthermore, according to the Mandaue City ORDN NO. 13-889-2014, the BRW WQMA governing Board is tasked to adopt and implement the crafted 10-year Action Plan. Thus, the BRW WQMA governing board functions beyond water pollution control. They also implement public awareness programs (e.g., Bayanihan sa Butuanon) to instill a sense of responsibility in their stakeholders. According to its Chairperson, one of the main goals of the BRW WQMA governing Board is to increase public awareness of present state of BRW which may result in a positive attitude and behavioral change among the locals and eventually lead to constituent-initiated and sustainable initiatives in protecting the river.

3.3 Butuanon River Watershed Management Board Initiatives

A 10-year Action Plan was created by the BRW WQMA GB to improve the water quality of the BRW [9]. The GB assists the LGUs in preparing their compliance schemes in its implementation. They also created local legislation to protect BRW and promote overall environmental improvement in the WQMA. This is evident in the resolutions mentioned in their 2017 Annual Report [11]. One example is Mandaue City Resolution No. 2-2017. The resolution pushed for creating a sewage treatment facility in one of the outfalls in Mandaue City.

In 1996, Mandaue City leadership continued to propel their efforts in creating policies that protect the environment. Through ORDN NO. 07-022-1996, the city challenges all their constituents, specifically the huge industrial companies, to protect their environment, including all their natural. Before the 90's ended, the last ordinance that was motioned was about the construction of septic tanks for the households that live in the city. ORDN. NO. 07-07-1998 moves to promote appropriate sanitation measures and prevent further contamination of the aquifers from human waste.

Subsequently, in the early 2000s, the Mandaue City LGU continued the creation of ordinances that promote environmental protection. ORDN NO. 08-02-2001 improves selected sections of ORDN NO. 07-022-1996, which expands the challenge not only to the big companies but also to learning institutions, private establishments (e.g., commercial, factories, department stores, hotels, restaurants, grocery stores, cinema houses, public market, service shops, entertainment joints), and all other similar establishments and church institutions. With this, the unit recognizes the need for a unified action that promotes environmental protection, as all citizens, regardless of social status, affect the environment with their daily decisions and activities; thus, the responsibility should be burdened on big companies and every individual.

The efforts of BRWMB in rehabilitating the river started with their establishment in 1996. Subsequently, Mandaue City LGU implemented local ordinances that prevent further river pollution and conducted numerous rehabilitative activities such as clean-up drives, tree planting, landscaping, and building of erosion and flood control structures (Table 1). BRWMB also identified the presence of informal settlers along the riverbank. In those activities, there were instances in which the public and private sectors worked together. The result of the interview with the DENR EMB-7 officials affirmed the efforts of Mandaue City towards rehabilitating Butuanon River. According to them, these efforts started with creating local policies and ordinances, eventually expanding into other activities.

"There were kanang mga previous rehabilitation efforts in that area. In fact, there was already a framework plan on that...mga long, earlier in 2000." – (A. Dinoy, personal communication, March 15, 2019)

There were already rehabilitation efforts previously done in that area. In fact, there was already a framework plan on that around long, earlier in 2000.

Table 1. Summary of initiatives done by the BRWMB before and after the creation of BRW WQMA according to the members

Initiatives	Before BRW WQMA	After BRW WQMA
	Frequency (n=43)	Frequency (n=46)
Rehabilitative activities	20	25
Efforts involving the public and private sectors	13	18
Efforts making use of management instruments	5	7
Policies and ordinances	5	4

Table 2 shows the list of the activities done by the BRWMB before it was designated as WQMA as identified by its members. Noticeably, efforts such as the "Adopt-an-Estero" program by the DENR and similar actions, e.g., clean-up drives and Information Education Communication (IEC) activities, were mentioned more frequently.

Table 2. BRWMB members' identified activities before the designation of BRW WQMA

List of the identified activities done before Butuanon River Watershed became a WQMA

Participate in the "Adopt-an-Estero" Program of EMB.
Awareness campaign on the member companies of the Chamber to support the endeavors of LGU for a cleaner and greener Mandaue
Water quality testing periodically
Erosion Control and Flood Control Project; Cascading stakeholders as to the objectives
Having clean-up drives with all LGUs, planting more plants for making a beautiful park.
Tree planting, river clean-up, IEC, plan for flood control
Conducted consistent clean-up drive for the Butuanon River
Profiling of illegal settlers, greening/establishment of river plants, installation of biofence, organizing stakeholders in the Adopt-an-Estero Program, river clean-up, water quality monitoring
Monthly clean-up
Improvement of water resources
Adopt-an-Estero/River Program
Tree planting, weekly river clean-up

3.4 BRW WQMA Initiatives

In 2011, DENR EMB-7 launched the "Adopt-an-Estero" in the region. Nine out of 10 barangays identified to participate in the project were from Mandaue City. The program also enlisted the help of various non-government organizations (NGOs), schools, and local students within the barangays that run along the Butuanon River. Aside from multiple clean-up activities, mangrove planting was also conducted in chosen sites, and an information campaign was conducted in the communities where the clean-up drives were conducted [11].

During this study, it was discovered that Mandaue City's efforts towards rehabilitating the river started with local policies to ensure that all efforts towards river rehabilitation are implemented. Metropolitan Cebu and EMB-7 launched the Metro Cebu Environmental Improvement Project in 2001 to support these efforts.

In this paper, the health of the Butuanon River was reviewed from 1992 until the first half of 2001 through the water quality monitoring system of the DENR EMB-7 office. The parameters used in monitoring the water quality were still the same: the BOD level (mg/L) and DO level (mg/L). Results showed that the BOD level fluctuates yearly through time, with the highest value dating from 1998, 81.69 mg/L. It was also found that the DO level keeps decreasing, and the lowest value was found in the same year at 1.72 mg/.

Another initiative by Mandaue City was the implementation of the Community-Based Monitoring System (CBMS). As part of the major projects of the then-administration, the tool was used to measure good governance through the data gathered by CBMS. The city also utilized the data in formulating needs-based, client-specific plans and programs monitored by the same tool. In the following year, the local government of Mandaue, through ORDINANCE NO. 10-372-2006 pushed for a stricter penalization of improper solid/liquid waste management. The ordinance also included fines to be collected from the violators and giving them citation tickets outlining the type of violation and their corresponding fine and penalty. The deputized Eco-Wardens of the city issue the tickets. Through this ordinance, the city also empowered their barangay councils to actively look for violators by providing them tickets to be given in case of any.

After the inception of the BRW WQMA in 2014, the activities of BRWMB to rehabilitate the river increased. The informal settlers identified in Mandaue City's Comprehensive Land Use Plan (2016) have already been relocated. Moreover, there was also an increase in the activities that promoted the public and private sectors to work together in their efforts. Lastly, initiatives such as using management instruments such as fund management, information management, monitoring and evaluation, etc. also increased during this time. These results support the findings of Hooper (2006), who said that [management] efforts should also be integrated with the plans that coincide with the local community's culture and values [12].

The BRW WQMA GB, through its partner LGUs, has fostered good partnerships with their area's academic and business sectors. As a result, multiple activities have sprung up since 2016. The largest among their endeavors were the recently concluded International River Summit and the completion of the viewing deck. Through the coming together of stakeholders, each opportunity has facilitated the exchange of knowledge and ideas. Moreover, the interconnectedness and the need for each stakeholder to come together in all its efforts is evident in the rehabilitative work done by the leadership of the LGU. The BRWMB Chair's earlier statement shows the significance of the consistency of doing the plan and involving stakeholders in its actualization. This creates a foundational aspect of the rehabilitation of the river. Despite misunderstandings, the governing body and the BRWMB continue to work on its initiatives as mandated by the government and their technical working groups. The crucial role of each stakeholder was reiterated in the study conducted by Handayani, W., Dewi, S.P. & Septiarani (2023), where national and local government organizations, business sector, universities and non-government organizations (NGOs) have different but significant roles in water governance [13]. Furthermore, a study by Alhassan Ibrahim, Katharine Bartsch & Ehsan Sharifi (2023) revealed that various actors in water governance like the state, private agencies, citizens, NGO, coalitions and others, provided crucial roles like bipartisan support, regulation enforcement, knowledge and beliefs, leadership and expertise, and incremental funding [14]. Similarly, a study by Carr et al. (2022) showed that water quality changes as a response to changes in stakeholders' awareness levels and institutional capacities [15].

In Naguilian River System-WQMA in La Union, Philippines, four years after it was named as WQMA, the Naguilian River which is the official entry of DENR-Region I for the year 2020, bagged the 1st place as the "Cleanest River Nationwide". The Board recognized the important collaborative efforts of various stakeholders in the province [2]. So crucial that other WQMAs like the Bacuit-El Nido Bay (BENB-WQMA) welcomed the participation of the Philippine Council for Sustainable Development (PCSD) in 2022 as the Board continue to address the challenges of improving the

water quality of BENB [16].

On the other hand, the BRW WQMA governing Board encountered challenges in program implementation (Table 3) such as the slow implementation of programs due to the lack of output in septage management and fund usage. Additionally, due to the division of the river, there have been instances of misunderstanding between the BRW WQMA governing Board and the BRW WQMA. The same issue is also prevalent in the study of Malenab et al. (2016) in a WQMA from a different area [17].

Aside from pertinent pollution problems, a lack of staff and internal conflicts among the EMB 7 board contributed to the rehabilitation's lack of progress. Additionally, some members of the Board are not serious about their involvement in the management as they no longer participate in the meetings. Aside from the problems in human resources, the Board also expressed its lack of funding to actualize its plans for the rehabilitation of the river. Still, through the designation of the river as a WQMA, the Board sees a new hope for managing the water resource [18].

A study by Rola et. Al (2015) on challenges of water governance in the Philippines revealed that the many legal documents for water are a source of confusion, that water data for planning are inadequate, that there are numerous water agencies, these are not connected vertically nor horizontally; and, that these various institutions do not have sufficient human and financial resources and presence at the local level to be effective in their mandates [19].

Table 3. Summary of challenges encountered by the BRW WQMA Board members in the implementation of their programs.

Challenges	Frequency (n=20)
Slow implementation of programs (i.e., lacking output in septage management and fund usage (AWQMA))	9
Division and dispersal i.e. misunderstanding between BRWMB and WQMA Governing Board as the river is segmented	8
Redundancy i.e. overlapping actions and members	3

3.5 Butuanon River Watershed Water Quality

One of the parameters used to determine a river's water quality is the biological oxygen demand (BOD) level. It is the amount of oxygen needed to be utilized by microorganisms to decompose waste in the water per liter. The BOD level would also decline as the waste is consumed or dispersed through the water [20]. Before the BRW WQMA 2014 creation, the BOD level of the river did not meet the water quality guidelines of DENR as it had a higher level than the standard BOD level with year. This indicated that there was an increased amount of pollution in the water.

Due to the river being divided, various issues were identified and found to be targeted by one of the main objectives of the 10-year Action Plan of the BRW WQMA. Specifically, the first objective of the Board is to reduce the 2014 BODs load in Butuanon River by 50% in 10 years. On the same plan, numerous problems similar to the mentioned studies above consolidate the issues that affect the river the most. For the BOD level, the problems that affect it greatly are domestic pollution, lack of wastewater treatment facilities from industries and identified key point source generators, increasing number of non-registered industries that dump on the river, and illegitimate wastewater operators [9].

Figure 3 shows the BOD level of the Butuanon River from 2007 to 2017, based on the BRW

WQMA's monitoring. However, there was an increase in BOD level in 2010 from 51.75 to 200.97. It has progressively decreased in the succeeding years, with the latest BOD level of 45.62 in 2017.

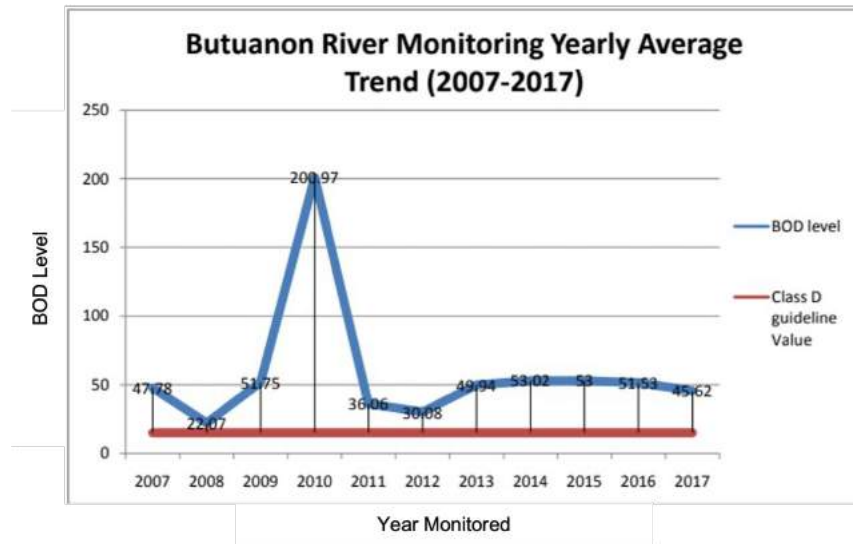


Figure 2.

Butuanon River Monitoring Yearly Average Trend of BOD Level (from Butuanon River Watershed Water Quality Management Area Secretariat, 2017)

The level of BOD in the Butuanon River in 2017 varied from the 11 monitoring sites, located from upstream to downstream of the whole river system. These are in Binaliw II, Candurung Pulang-bato, Sta. Lucia Bridge, Bacayan Bridge, Canduman Bridge, Pilit (HJR Outfall), Old Pilit (near Treasure Island), Greenhills Outfall, Tingub Bridge, Butuanon Bridge, and Cambogaong Bridge. As seen in Figure 4, the levels of BOD increases as the water flows to the downstream. With the highest level on Cambogaong bridge in all four quarters. At the same time, the three sites with the lowest level are located in Cebu City which is also the upstream of the river. Officers of the BRW WQMA claimed that since the Butuanon River is a divided river system, various polluting sources can be found along its path. Most of the domestic communities are in the upstream, while the agriculture and industries are located in the downstream.

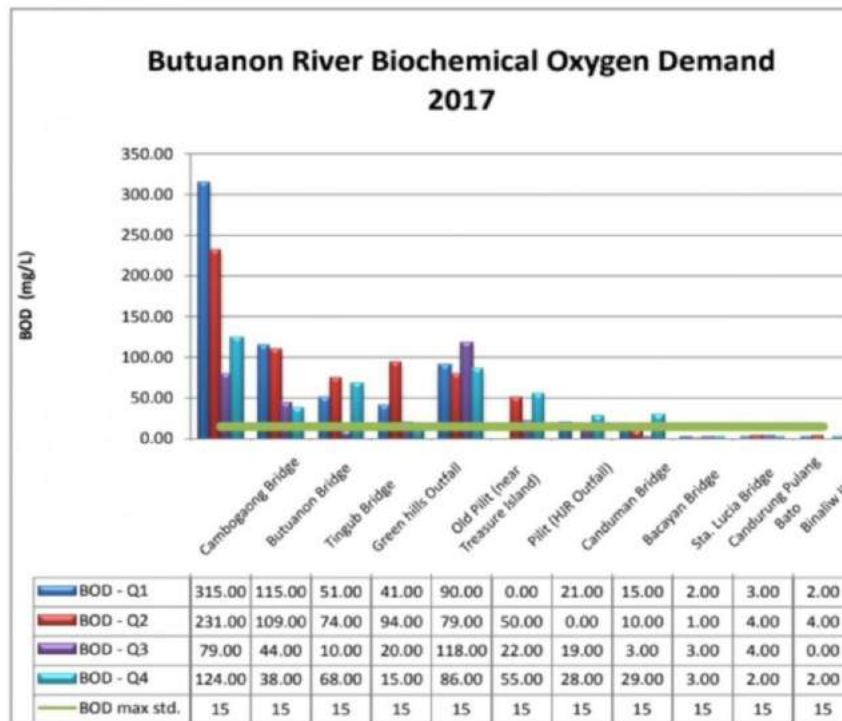


Figure 3.

Butuanon River Biochemical Oxygen Demand Level (from Butuanon River Watershed Water Quality Management Area Secretariat, 2017)

In terms of the level of DO in 2017, Figure 5 shows the varying DO levels from upstream to downstream as well since D level is necessary for the respiration of aquatic organisms. With the highest level of DO located upstream, Binaliw II, this indicates that the aquatic ecology in the area is thriving. As observed, the further the water flows downstream, the level of DO decreases with the lowest at Old Pilit, Butuanon Bridge, and Cambogaong Bridge. All of which are located downstream from the river. This can explain the downstream's lack of living aquatic organisms since they cannot survive in the water without DO. Moreover, the lack of DO in the same area can also be traced from the presence of other chemicals that were found in the studies of [21, 22, 23]. Such chemicals are also hazardous to the river's natural flora and fauna.

Additionally, the Total Suspended Solids (TSS), pH level, and river temperature are parameters included in the quarterly water quality monitoring of the BRW WQMA. Figure 6 shows the level of TSS in mg/L, with the highest recorded level in the second quarter on the site at Sta. Lucia Bridge. However, most findings are below the standard even with residential areas surrounding the upstream of the river.

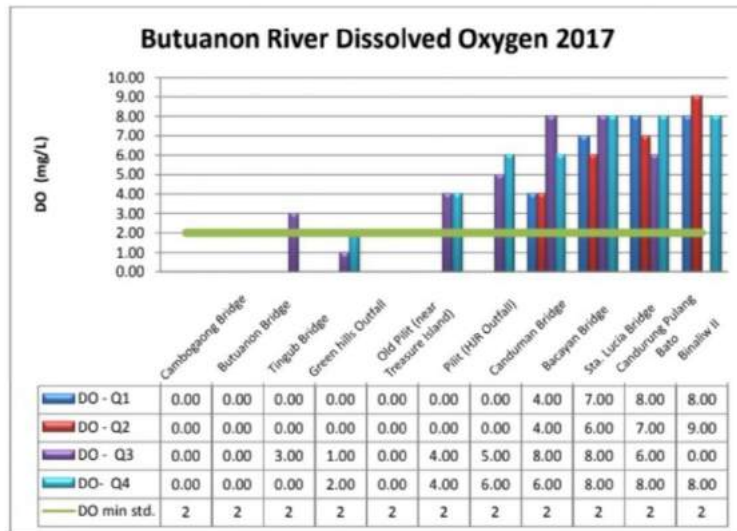


Figure 4.
Butuanon River Dissolved Oxygen Level (from Butuanon River Watershed Water Quality Management Area Secretariat, 2017)

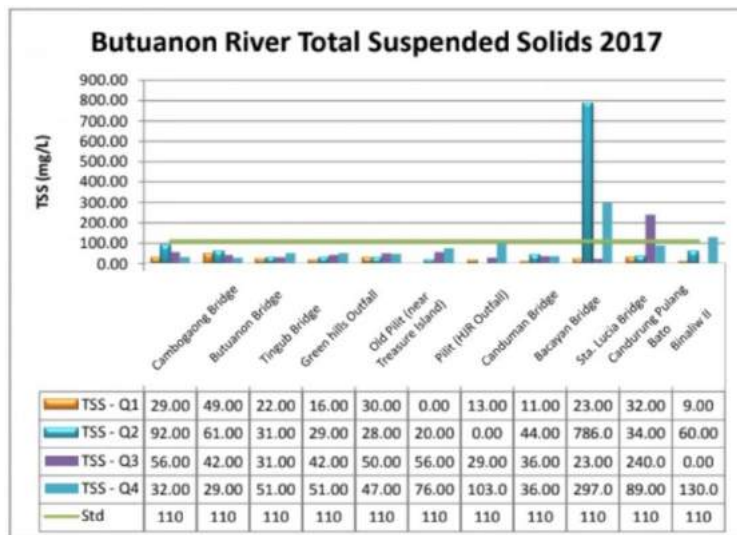


Figure 5.
Butuanon River Total Suspended Solids (from Butuanon River Watershed Water Quality Management Area Secretariat, 2017)

Measures to counter the number of pollutants that contaminate the river started even before the BRW WQMA and the BRWMB existed. In 1994, Mandaue City's Sangguniang Panglungsod wasset to create ordinances that advance environmental protection. Mandaue City ORDN. NO. 14 Series of 1979 was amended to permit industrial companies to submit their Environmental Compliance Certificate from the DENR to the city office before securing a clearance for their Zoning Compliance [24]. The following year, the LGU also motioned through the same governing body another ordinance that forbids the dumping of toxic wastes on the Butuanon River and penalizes those who will do otherwise. Ordinance No. 06-07-1995 further stipulates the substances that should not be thrown into the river. These include auto batteries, household batteries, leather, medicines, metals, oils and gasoline, paints, pesticides, petroleum products, plastics, textiles, food wastes, hard wastes, glasses and similar inorganic wastes. Another ordinance was passed that determines the procedures and rules the city should practice for proper solid waste management and garbage disposal.

4 Summary and Conclusion

Since the creation of the BRW WQMA, the river's water quality in terms of the BOD level has been decreasing. However, it is still beyond the standard BOD level from the water quality guidelines of DENR for a Class D water body. The efforts of the BRWMB have started since their establishment in 1996. They have created five local ordinances through their partner LGUs to prevent further river pollution. They have also conducted 20 rehabilitative activities, mainly clean-up drives, tree planting, landscaping, and building erosion and flood control structures along the river. After the inception of the BRW WQMA in 2014, the BRWMB as a local organization of the constituents headed by the Mandaue LGU, has continuously conducted rehabilitative activities where they have involved the public and private sectors in action. The Mandaue LGU, through DENR, created the BRWMB in 1996 and became a member of the governing Board of the BRW WQMA in 2014. The roles and functions of the WQMA board are stipulated in DAO-2014-05, while for BRWMB it was formalized in their local ordinance no. 13-889-2014. In the same ordinance, the roles and functions of the Board are declared, and they exist as a reinforcing body of the efforts of the BRW WQMA. One of the major accomplishments of the BRWMB and BRW WQM was the creation of the Butuanon River Rehabilitation Plan, including the development of a Mangrove Eco Park. Additionally, the BRWMB and BRW WQMA acted as a link among the LGU, other sectors and the local community members in the continued rehabilitation and conservation of the rivers in the Mandaue area. The efforts of each stakeholder were evident in their contribution to the plans and projects and participation in the efforts towards the rehabilitation of the river. However, various challenges such as management, internal conflicts, etc., were also observed during the project implementation.

5 Recommendations

Regarding the river's water quality, BRWMB and DENR EMB 7 should regularly inspect the source points that contribute to the river's pollution. This way, industries not compliant with the implemented policies should be penalized. To support the Boards activities, additional funding may also be drawn from the fines gathered that could be used to fund future projects of the Board, leading to an improved water quality that meets the DENR's standards.

These efforts done by the BRWMB and BRW WQMA GB were found to have positive impacts, both on the quality of the river and the relationship of the stakeholders. Thus, all rehabilitation efforts should be sustained and enhanced with the synergy of all stakeholders' resources. The public may also be involved by conducting intensive information and education campaigns especially to communities and industries along the river. Engaging the people in the cleaning and rehabilitation of the river will be more sustainable since they will see the value of the concerted efforts of the

different stakeholders.

For future research, studies on the level of awareness of the specific roles and functions of the BRWMB and/or BRW WQMA governing Board are encouraged. It may also investigate comprehensively the other aspects of the study. Other social parameters such as the attitude and behavior of local communities in terms of water management and impact assessment studies may also be explored. Research on how other WQMA in the country are doing to improve their respective water systems are also recommended.

Finally, their organizational mandates and functions must be reviewed and revised to address the slow implementation and redundancy, especially those in the BRW WQMA governing Board. This may reduce the risk of misunderstandings and internal conflicts between and among BRWMB and BRW WQMA members.

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